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ONLINE: WPI, JAPIO, EPODOC

(54) Abstract Title
Baby monitoring unit indicating sound amplitude via variable light intensity

(57) A monitoring unit comprises a transmitter unit, located near the person to be monitored, e.g. a baby, and a receiver unit 20 located near a minder. The transmitter unit includes a microphone 10 and transmission means adapted to transmit a signal dependent on the level of sound measured by the microphone 10. The receiver unit 20 receives the transmitted signal and has at least one light source 29 whose intensity is varied as a function of the amplitude of one or more frequencies of the sound measured by the microphone 10. Preferably the light source comprises one or more light emitting diodes (LEDs) which may be arranged in a curve 29 to represent a "smile". The light intensity may vary linearly or logarithmically with the sound level. A loudspeaker 26 may also transmit the sound and the intensity of the light source 29 is independent of the loudspeaker's volume control.

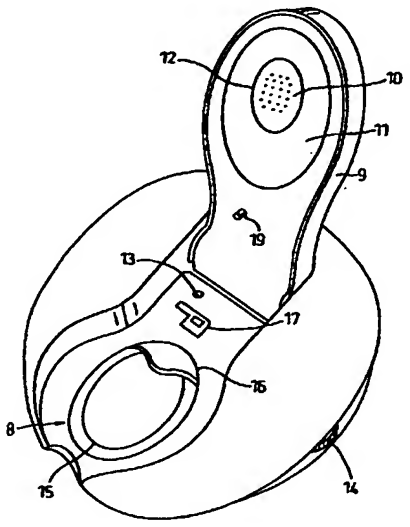

Fig. 5

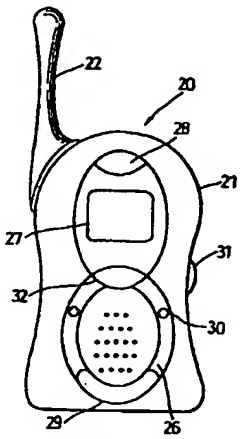

Fig. 7

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

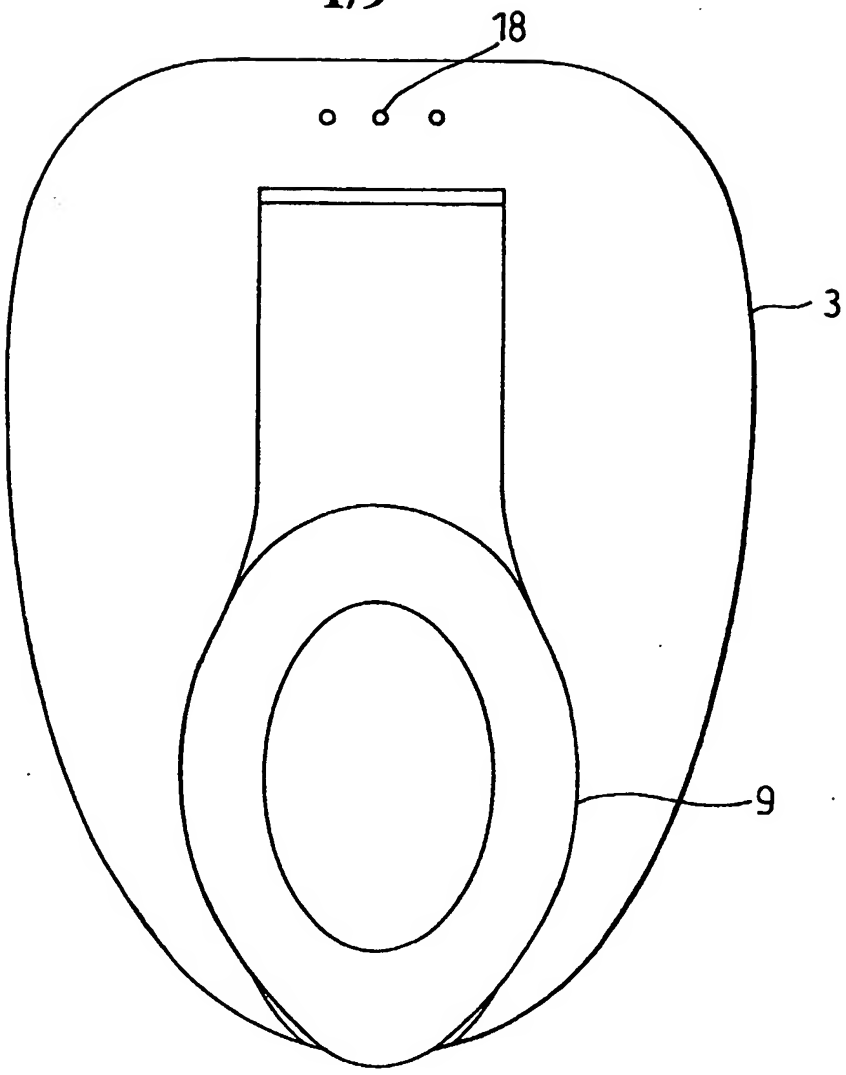

Fig. 1

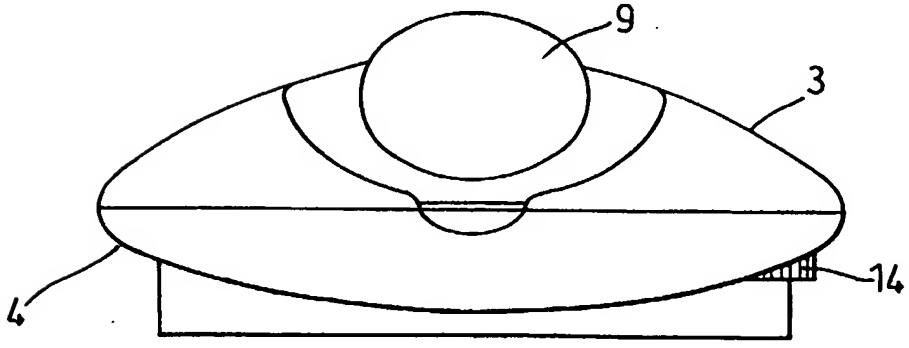

Fig. 2

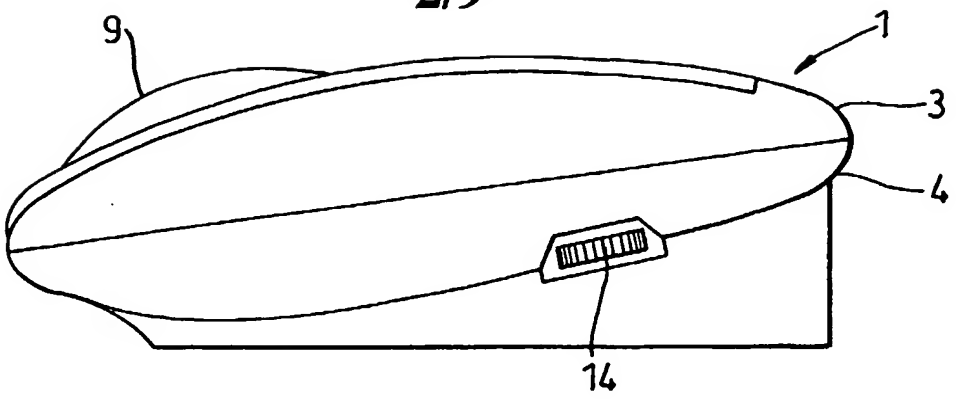

Fig. 3

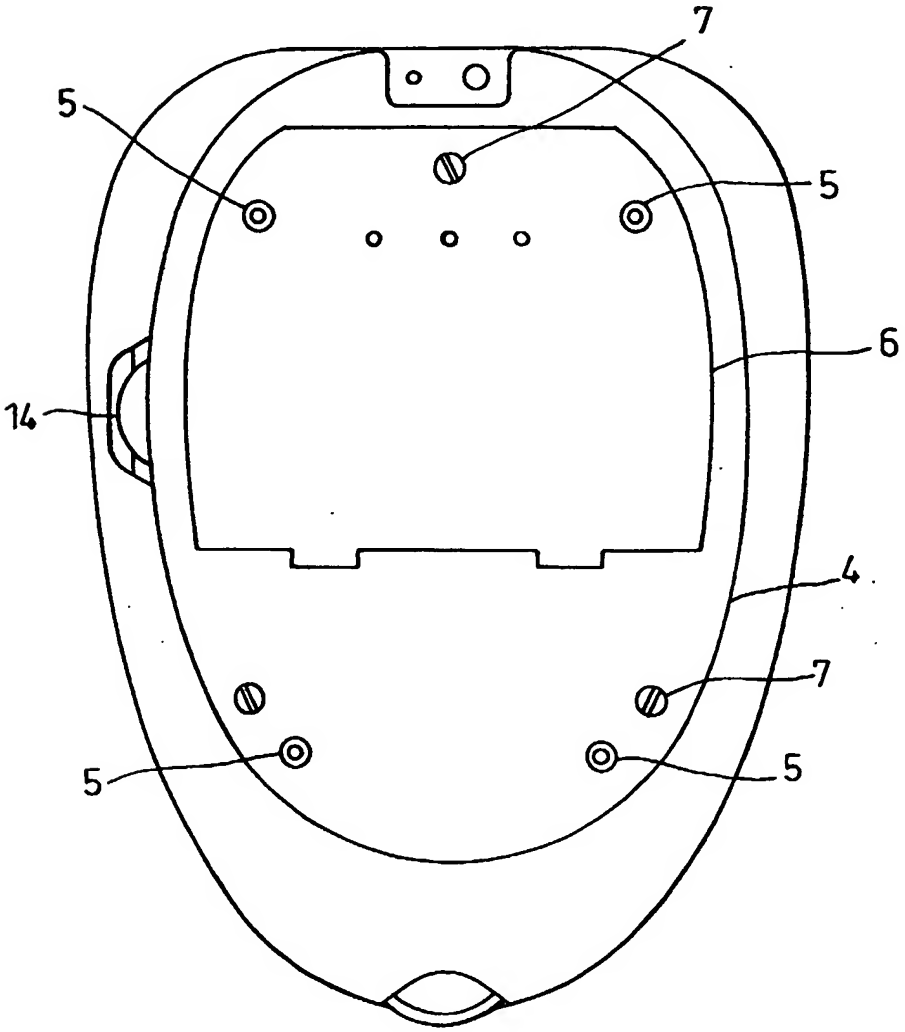

Fig. 4

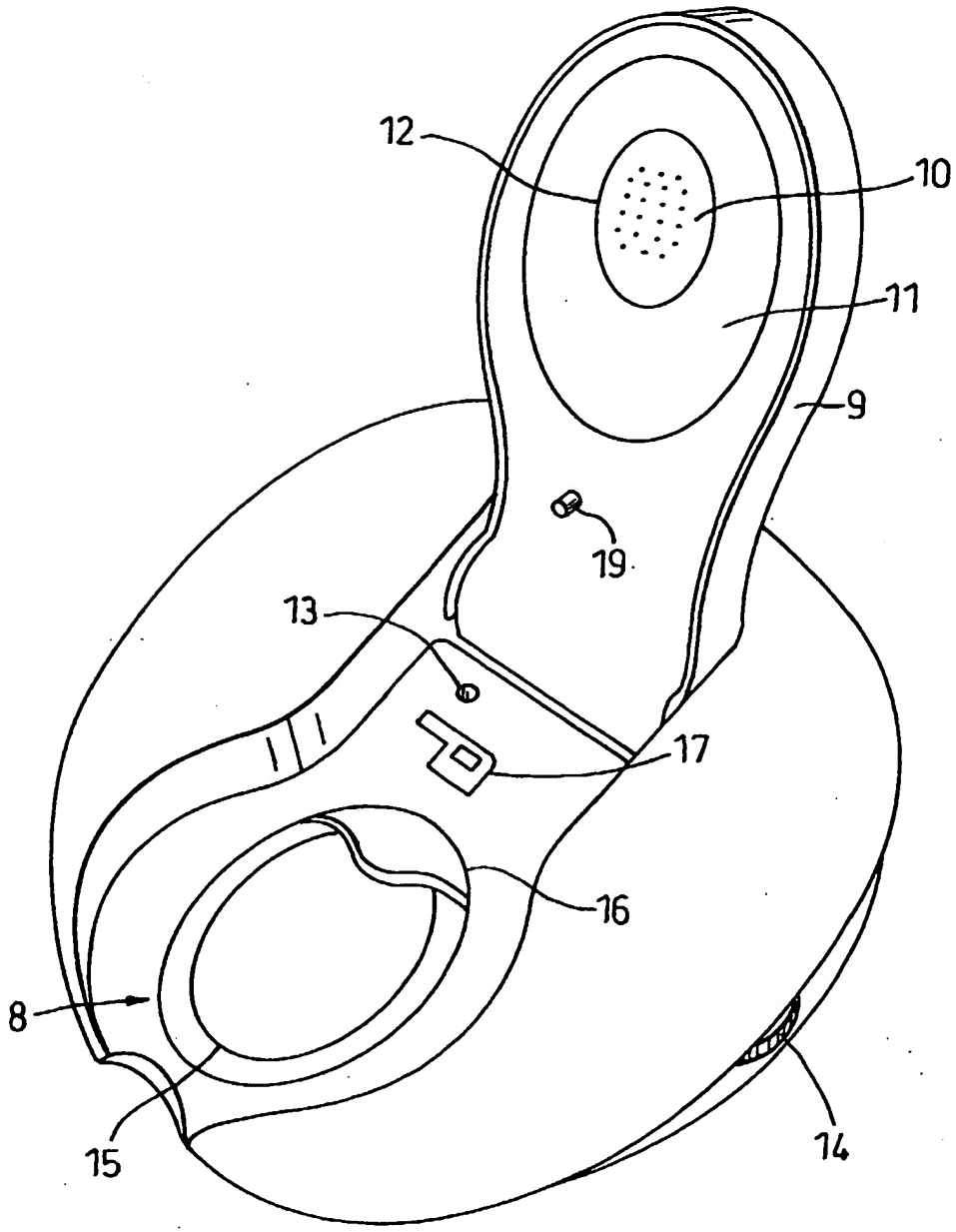

Fig. 5

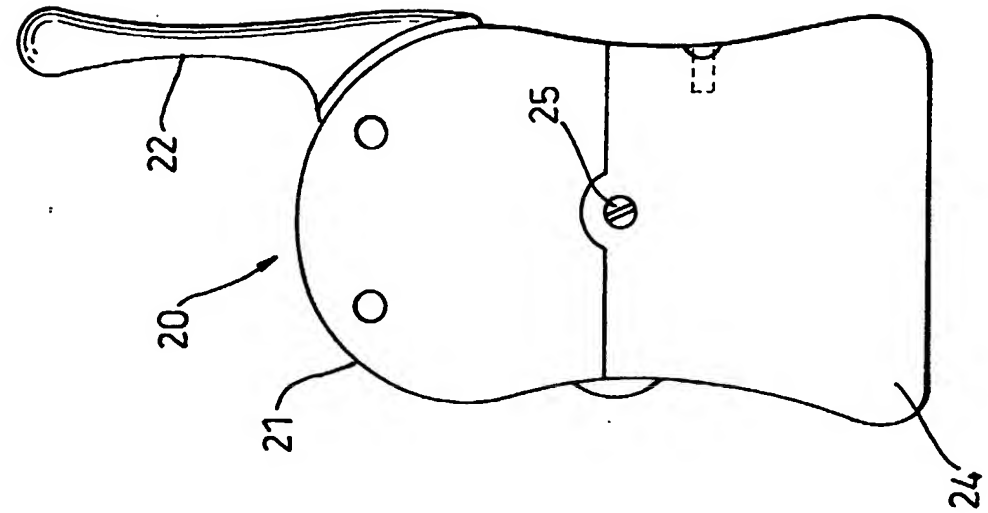

Fig. 8

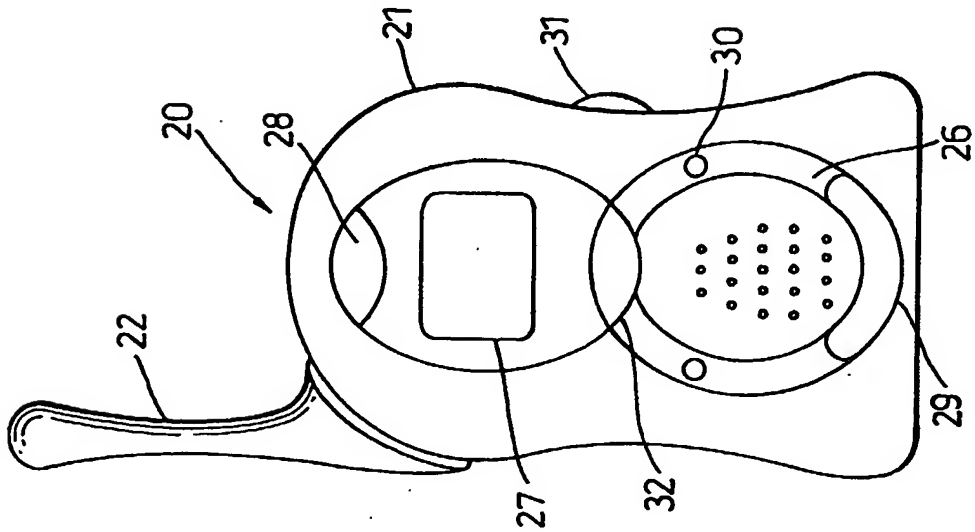

Fig. 7

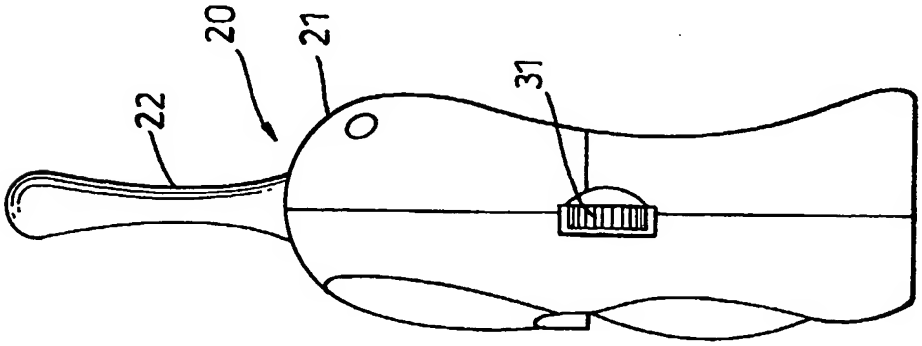

Fig. 6

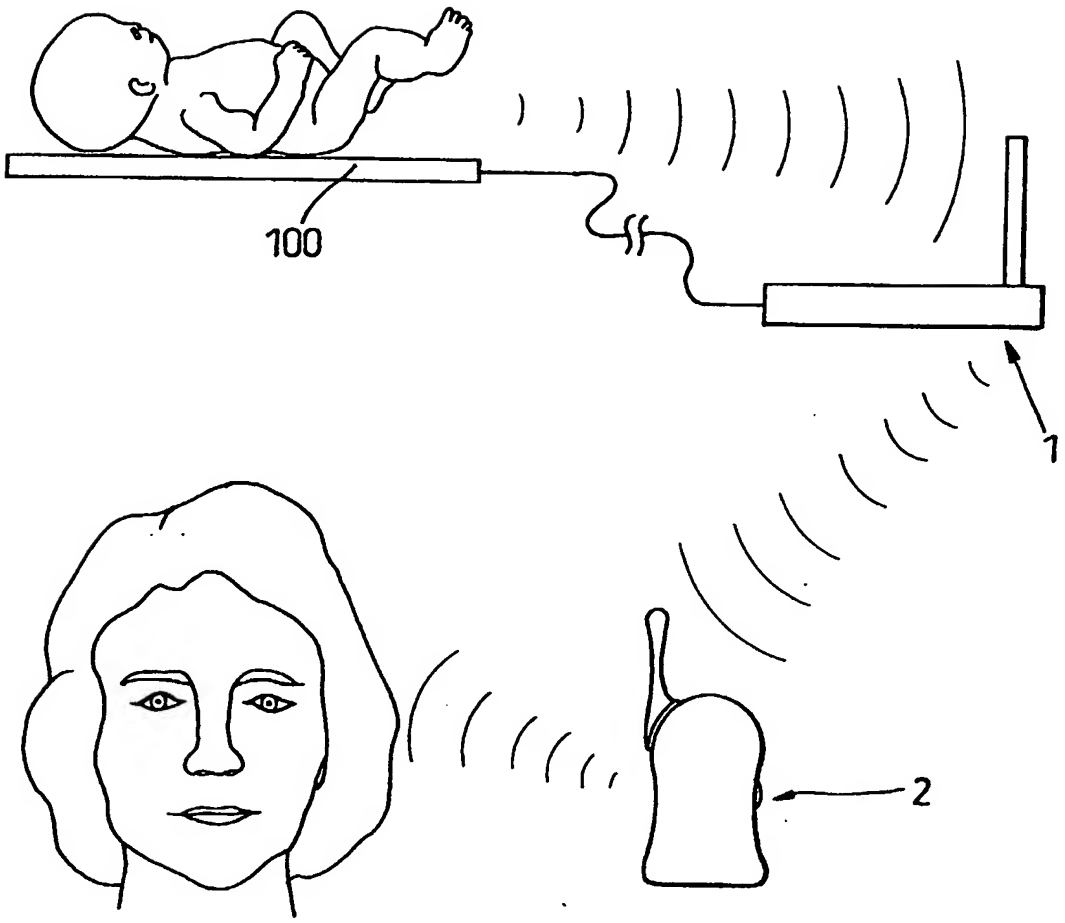

Fig. 9

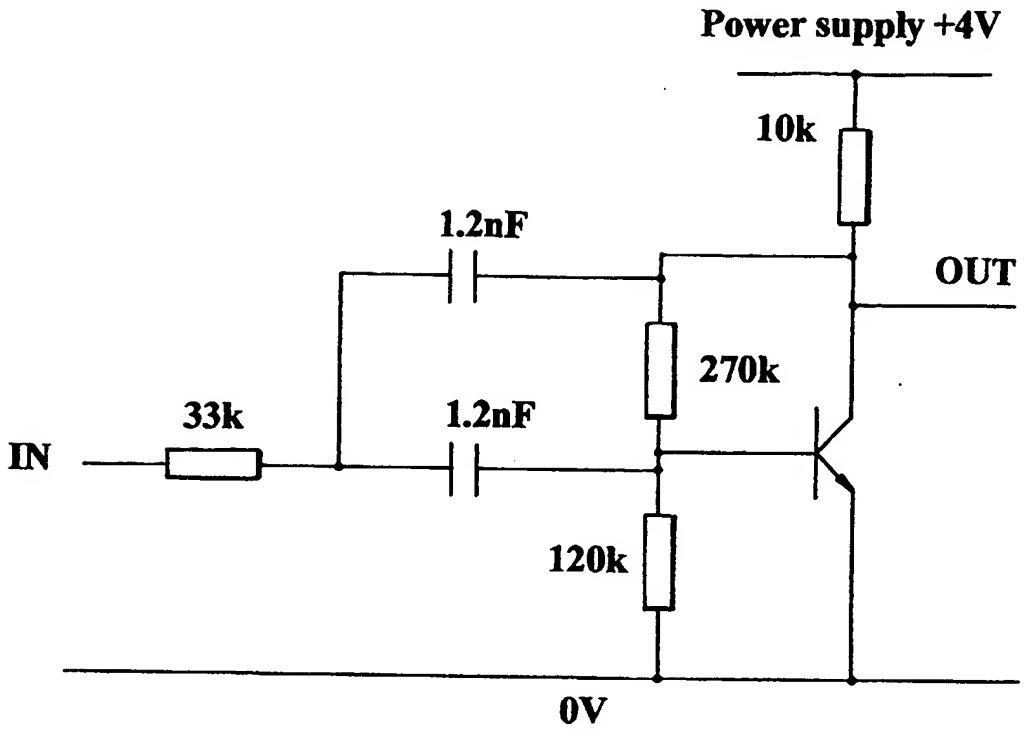
Power supply +4V
10k
1.2nF
OUT
270k
33k
1.2nF
IN
120k
0V

Fig. 10

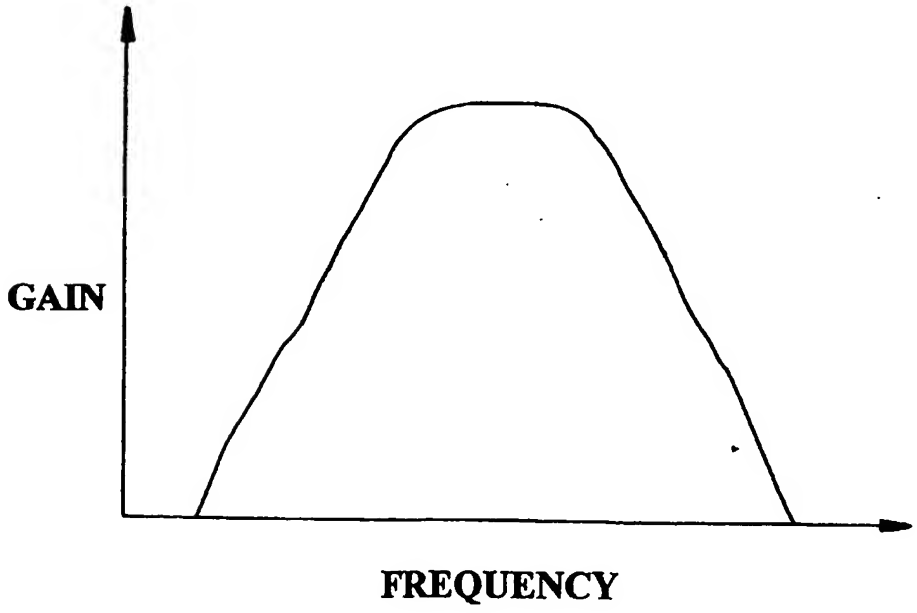
GAIN
FREQUENCY

Fig. 11

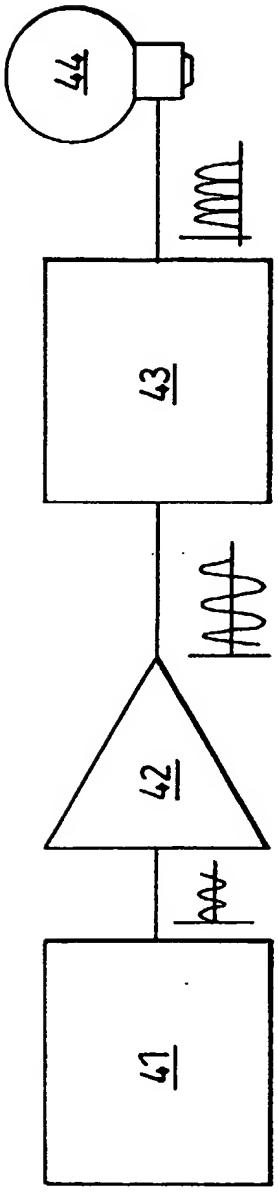

Fig. 12

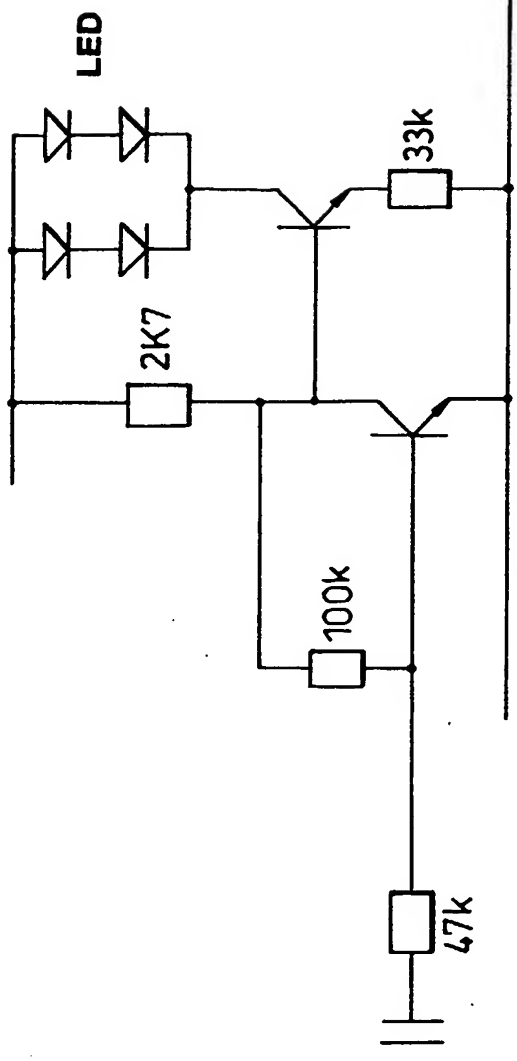

Fig. 12(a)

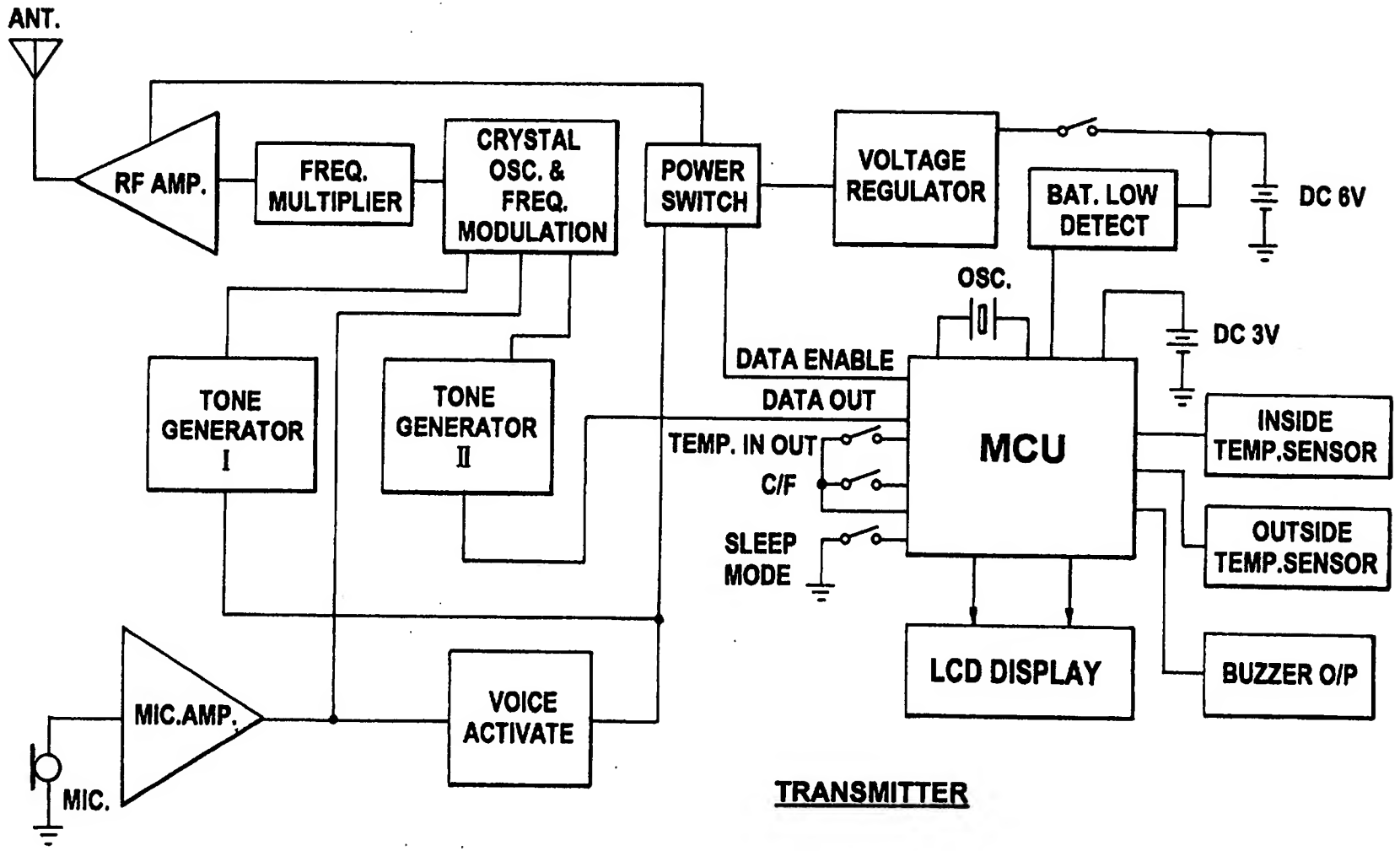
ANT.
RF AMP.
FREQ. MULTIPLIER
CRYSTAL OSC. & FREQ. MODULATION
POWER SWITCH
VOLTAGE REGULATOR
BAT. LOW DETECT
DC 6V
OSC.
DC 3V
DATA ENABLE
DATA OUT
TEMP. IN OUT
C/F
SLEEP MODE
MCU
INSIDE TEMP.SENSOR
OUTSIDE TEMP.SENSOR
TONE GENERATOR I
TONE GENERATOR II
LCD DISPLAY
BUZZER O/P
MIC.AMP.
MIC.
VOICE ACTIVATE
TRANSMITTER

Fig. 13

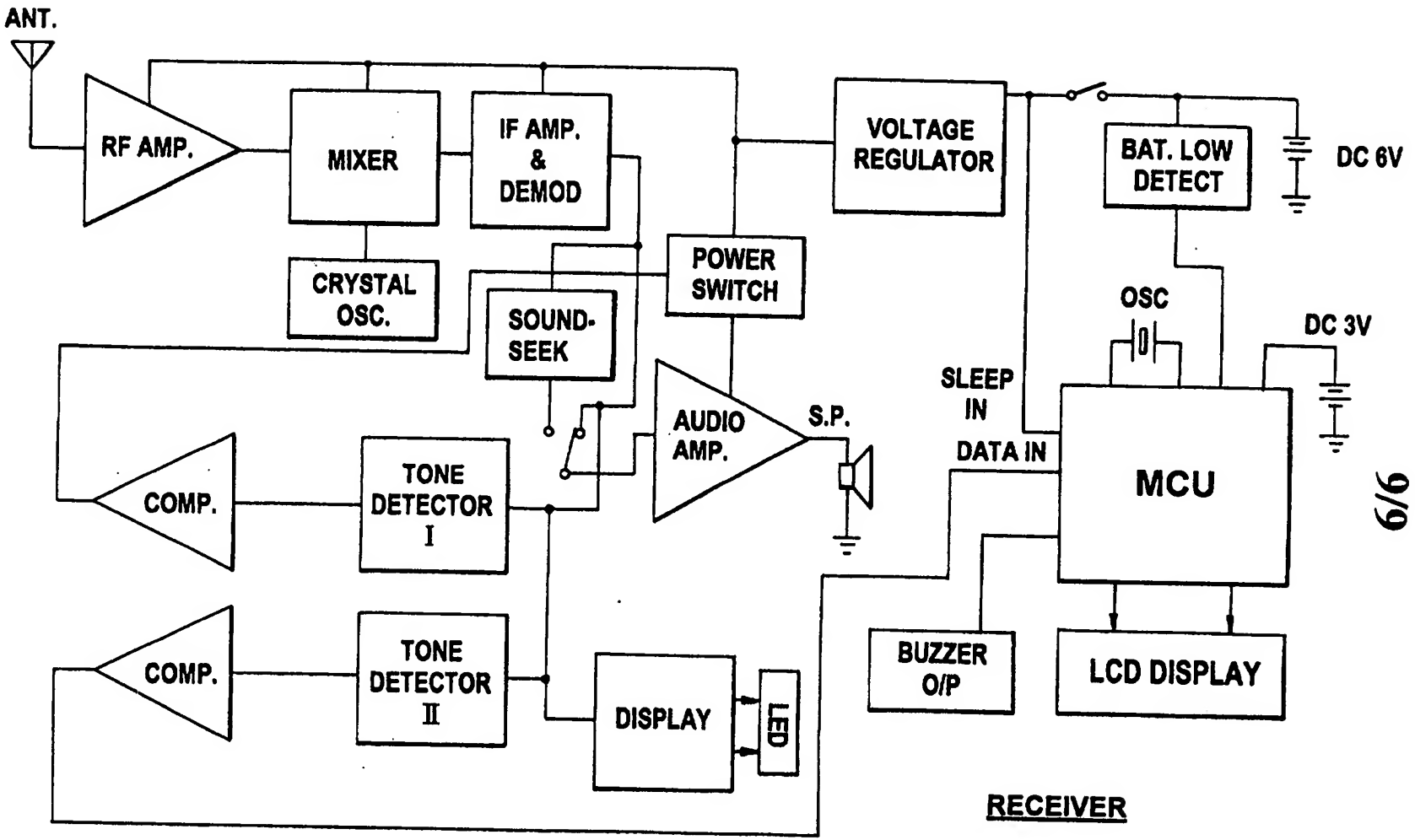
ANT.
RF AMP.
MIXER
IF AMP. & DEMOD
VOLTAGE REGULATOR
BAT. LOW DETECT
DC 6V
CRYSTAL OSC.
POWER SWITCH
SOUND-SEEK
OSC
DC 3V
SLEEP IN
DATA IN
AUDIO AMP.
S.P.
MCU
COMP.
TONE DETECTOR I
COMP.
TONE DETECTOR II
DISPLAY
LED
BUZZER O/P
LCD DISPLAY
RECEIVER

Fig. 14

A MONITORING UNIT

This invention relates to improvements in monitoring units, and in particular devices allowing the monitoring at a distance of a baby in its room.

In the early stages of a baby's development, it is important for a child's mother or father, or whoever is minding the baby, to be able to hear any noises, and in particular cries, that the child may make. In many households it is not always possible for the minder to be near enough to directly hear the baby, or at best it is inconvenient. For this reason, it is common to provide some sort of baby monitoring device that enables sounds made by a baby to be remotely monitored.

A typical device comprises a microphone located in the child's room and a transmitter associated with the microphone that transmits detected sounds to a receiver where they are converted to an audio signal that drives a small loudspeaker. Any noises made by the baby are therefore reproduced on the loudspeaker which can be conveniently located near the minder.

Whilst such devices have had considerable success, and offer real benefits for the minder, they are of limited use in noisy environments where they may be inaudible over background noise. Also the noise reproduced by the speaker can be very distracting if the minder wishes to watch television or listen to music whilst monitoring the baby.

An alternative to an audible output is to provide an optical indicator of the level of sound using a series of lights that are sequentially illuminated as the intensity of the sound increases. The lights are typically arranged in a row and are sometimes referred to as a bargraph display. This is the

usual manner of representing sound level used on audio reproduction equipment such as cassette recorders or mixing desks. The more lights that are illuminated, the louder the sound.

The applicant believes that the provision of such a visual indicator is not optimal for a baby monitoring unit. A minder may adapt a "mind-set" that the baby only needs to be checked if all the lights are illuminated, or all but one light. Since the number of lights that are illuminated for a given sound level will depend on the distance from the baby to the microphone, this can lead to a dangerous false belief that all is well unless all lights are lit.

An object of the present invention is to provide a monitoring unit, suitable for monitoring a baby, which provides an indication of noises made by a baby that ameliorates the above-mentioned risk of complacency by a minder.

In accordance with a first aspect the invention provides a monitoring unit suitable for enabling a minder to monitor noises made by a person from a remote location, the unit comprising:

a transmitter unit that can be located by a person to be monitored and including a microphone and a transmission means adapted to transmit a signal dependent upon the level of sound measured by the microphone;

a receiver unit adapted to be located by a minder and including a receiver which is adapted to receive the transmitted signal; and

at least one light source, the receiver unit being so constructed and arranged that the intensity of light emitted by the light source is varied as a function of the amplitude of one or more frequencies of sound measured by the microphone.

The light source may comprise one or more incandescent bulbs or light emitting diodes or both. It preferably comprises a plurality of light emitting diodes. They may be incorporated into a housing of the receiver.

By providing a light source which varies in intensity rather than sequentially illuminated lights, the minder can no longer easily tell whether or not the light source is at maximum intensity or at some fraction of its maximum intensity. The false security often associated with sequential illuminated light is therefore avoided.

Preferably, the light source is only illuminated when sound is detected by the microphone. This minimises the distraction caused by the display during long periods of silence. Additionally, the minders eye will be drawn to the light as it illuminates when a sound is made. The light may be illuminated at a peak intensity when the sound level reaches a preset maximum level. The intensity may be varied linearly (or non-linearly) between these two extremes for sound levels between the minimum and maximum values.

In addition to the light source, a loudspeaker may be provided for audible reproduction of the detected sounds.

A volume control may be provided which permits the volume of sound reproduced by the loudspeaker to be varied. In one setting of the volume control, only a very low level of no sound may be reproduced by the loudspeaker.

It is preferred that the intensity of illumination of the light source is independent of the setting of the volume control from the loudspeaker.

In an alternative to a linear relationship between intensity and sound level, a logarithmic relationship may be used. This may be advantageous as the ear perceives sound levels logarithmically.

The intensity of the light may either vary in real time to follow the intensity of the sound (i.e. instantaneous changes) or a delay may be provided so that the intensity of the light decays at a predetermined rate after it is illuminated. Thus, the light may remain illuminated for some time after a sound has finished if required.

The audio signal fed to the input of the light circuit may be passed through a half-wave rectifier to produce a uni-directional signal before being fed to the light source. This is particularly appropriate for light emitting diodes which may fail if biased at the wrong polarity.

The transmitter may comprise an RF transmitter and the receiver may comprise an RF receiver. The transmitter-receiver may compare a VHF radio link including a sub-carrier modulated by the output of the microphone and a demodulator that extracts the audio signal from the carer signal. A frequency of between 30 and 70 MHZ, typically 50 MHZ, may be used.

The person being monitored may be a baby.

There will now be described, by way of example only, one embodiment of the present invention with reference to the accompanying drawings of which:-

Figure 1 is a view of a transmitting module of a baby-monitoring unit in accordance with the present invention seen from above;

Figure 2 is a view of the transmitting module as seen from the front;

Figure 3 is a view of the transmitting module as seen from one side;

Figure 4 is a view of the underside of the transmitting module;

Figure 5 is a perspective view from above and to one side of the module of Figures 1 to 4 in its operational position;

Figure 6 is a side view of a receiving module in accordance with the invention;

Figure 7 is a top view of the receiving module;

Figure 8 is a bottom view of the receiving module;

Figure 9 illustrates the location of the transmitting module and receiving module relative to a baby and minder when in use;

Figure 10 is a circuit diagram for a sound seek filter circuit incorporated into the receiving module;

Figure 11 is a plot of frequency against gain for the Soundseek circuitry;

Figure 12 is a schematic block diagram of a circuit that can be used to drive a visual indicator of sound that varies in intensity;

Figure 13 is a block schematic diagram of the electronic circuitry housed within the transmitting module of the baby monitoring unit of the present invention; and

Figure 14 is a block schematic diagram of the electronic circuitry housed within the receiver module of the baby monitoring unit of the present invention.

The baby monitoring unit comprises a transmitting module 1 and a receiving module 2. The transmitting module 1 is illustrated in Figures 1 to 5 whilst the receiving module 2 is illustrated in Figures 6 to 8 of the accompanying drawings.

Transmitting Module

The transmitting module 1 is in the form of a clamshell housing having an top portion 3 and a base portion 4 joined together at a seam 5 around the sides. The base portion 4 has four integrally moulded feet 5 on a generally flat base which permits the transmitter 1 to be placed in a stable position on a flat surface close to a baby. The base portion 4 also includes a receptacle for accommodating batteries (not shown) that will power electronic circuitry located within the housing. The receptacle is covered by a lid 6 secured by a single screw 7.

The top portion 3 of the housing has a generally convex form with an elongate central depression 8 extending from a front edge across the top towards, but falling short of, the rear edge of the top portion. A fold-up lid or arm 9 which has a form that is generally complementary to that of the depression is provided. This lid is pivoted at one end towards the rear of the depression 8 by a hinge (not shown) that is located within the depression 8. The lid 9 is movable between a lowered position in which it

covers the base of the depression and a raised position in which the lid 9 stands approximately vertically above the top of the housing. Figures 1 to 4 show the lid in the lowered position and Figure 5 shows the lid in its raised position.

The lid is a two part plastics moulding that has space provided between the parts for a microphone (not shown). The microphone is located wholly within the lid and exposed to the outside environment by a hole or cluster of small openings 10 formed in the lid towards its free end (i.e. away from the hinge). The holes 10 are only provided on the underside of the lid and so are covered when the lid is lowered and exposed when it is raised. A first portion 11 of the lid 9 surrounding the holes 10 is dished inwards (concave) whilst a second portion 12 in the centre of the dished area is slightly raised and accommodates the microphone openings 10. The end of the lid is therefore given the appearance of an ear, helping the user to identify with the listening function of the lid.

In use, the transmitting module 1 is placed on a surface near to a baby with the lid 9 raised and directed so that sound from the baby will fall upon the microphone in the arm for detection. When not in use, the lid can be folded down into the recess.

The lid also accommodates a radio frequency antenna (not shown). This extends up one side of the lid from the main housing, and is preferably arranged so that wires extending from the microphone to the main housing extend down the opposite side of the lid to avoid risk of electromagnetic interference.

An additional function of the fold-up lid is to act as a switch that automatically turns the transmitting unit 1 on when it is raised and off when it is lowered. This is especially beneficial in that it is then very

easy for a parent or minder to see that the unit is switched on when the lid is raised and off when it is lowered. An electrical contact that is displaced by the rotation of the lid is provided that either makes or breaks a connection between a power supply (i.e. the batteries) and electrical circuitry within the housing.

The microphone enables sound produced by a baby to be converted to electrical energy that is processed by electronic circuitry (not shown) accommodated within the housing. The antenna permits the processed sound signal to be transmitted to the receiver.

In addition to the microphone, a socket is provided towards the rear of the base for receiving a connector of a pressure sensitive pad. The pad 100 (which can be seen in figure 9 of the accompanying drawings) can be placed under a mattress on which a baby is resting, and generates an electrical signal that is passed to the input and then to the electric circuitry within the housing. The pad may be in accordance with our earlier British Patent Application No.GB9820659.2.

The lid acts as a cover for a number of functional features of the transmitting unit when it is closed and allows access to these features when opened. These are as follows:

Sensor light- A green light emitting diode (LED) 13 is located behind a complementary opening that is formed into the depression in the top of the housing. The LED 13 is adapted to illuminate or "flash" with each movement that the baby makes as detected by the sensor pad 100. In addition, circuitry is provided within the housing that is adapted to generate a short duration electrical pulse or "click" which is transmitted by the antenna to the receiving unit. The audible amplitude of the pulses is adjustable by a rotary volume control 14 provided on the side of the housing. It should be noted that the volume control does not adjust the

amplitude of the audible pulses and only changes the audible amplitude of the detected sound signal that is transmitted to the receiving unit.

Night Light- Also located in the depression of the housing below the lift-up lid is a small night light 15 which includes an on/off switch 16. When the lid is raised the light may be switched on to soothe and reassure the baby as well as helping to operate the unit in the dark.

Alarm switch- Optionally, an alarm on/off switch 17 is also located in the depression. When in the "On" position, the electronic circuitry located within the housing activates both an audible and visible alarm if the sensor pad has not detected any movement for more than 20 seconds. When the switch is in the "Off" position, the alarm is deactivated.

Temperature sensor- An optional temperature sensor is located within the housing below a small opening 18 in the rear of the housing or alternatively in the lift-up arm. The temperature sensor monitors the ambient temperature. This measurement is encoded by the electronic circuitry within the housing for transmission by the antenna to the receiving unit.

Power on indicator- A red light emitting diode 19 is moulded into the lid at its hinged end. This is illuminated when the electronic circuitry is receiving power. In the event of a power failure, such as a flat battery, the light is extinguished to provide a visual warning to the user. The light also flashes if the power source is running low and the rate of flashing increases as the power source decreases in strength.

Figure 13 is a block schematic diagram of the electronic circuitry provided at the transmitter module as follows:

MCU

This is a single chip microprocessor which controls all the sensor input signals.

Temperature

This is a temperature sensor that uses a thermistor for measurement.

MIC AMP

This is an amplifier that effects voice amplification to an appropriate level with gain control.

Voice Activate (optional)

This is to hold and compare the microphone signal, and output a control signal to trigger tone generator I and power switch.

Tone Generator I (optional)

This generates a 90Hz tone signal when triggered by the voice activate control, other tone generators can be added to convey other status information, e.g.,. alarm.

Tone Generator II

This generates a 135Hz tone signal, and is controlled by the MCU data signal.

Crystal OSC & Modulation

The signal frequency is modulated with the crystal oscillating frequency.

Freq. Multiplier

This multiplies the fundamental frequency to the third overtone carrier frequency.

R.F. AMP.

This amplifies the carrier frequency, and outputs it to the antenna.

Power Switch

This is a transistor power switch which controls the R.F. transmission.

Receiving module

The receiving module 2, which is illustrated in Figures 6 to 8 of the accompanying drawings comprises a two-part hand-held housing which has a flat base portion 21 that allows it to be placed on a flat surface in a room next to a parent or minder. The main function of the receiving module 2 is to capture radio signals transmitted by the transmitting module 1, decode the signals to extract the information contained within them, and present the information to the minder in either audible and/or visual form. The transmitted information includes an audio signal encoding the sounds measured by the microphone, the electronic sensor "click" signal indicating movement as detected by the sensor pad, and temperature information indicating the ambient temperature measured by the temperature sensor.

A flexible antenna 22 is attached to and extends upwards from the top of the housing 21 whilst a rear face 23 of the housing includes an access panel 24 which can be removed to permit batteries to be inserted into the housing. The access panel is secured by a single screw 25. The front face of the unit includes several functional features as follows:

Loudspeaker- A small loudspeaker (not shown) is hidden within the housing and produces sound waves that pass through a set of small openings 26 in the front face. The audio signal received by the receiver is processed by electronic circuitry within the housing and drive the loudspeaker so that sound detected by the microphone is reproduced.

Temperature display- An optional temperature display 27 is provided on the front face of the receiver module. This consists of a liquid crystal display panel capable of illustrating at least part of an alphanumeric character set. The characters are presented on the display to show the ambient temperature at the transmitting unit in either degrees Centigrade or Fahrenheit. Obviously, if the transmitting unit does not include a temperature sensor this display can be omitted. The display (where provided) is backlit so that it can be red even when there is little available ambient light.

Visual sound display- At the bottom of the front of the housing a curved transparent panel 29 is provided which covers a light emitting diode. The intensity of light emitted by the diode varies with the amplitude of the sound measured by the microphone. This provides an additional display of sound alongside the loudspeaker.

Figure 12 is a diagram of suitable electronic circuitry that can be used to drive the light emitting diode from an audio signal input extracted from

the antenna circuitry. The input signal 40 can be taken from the input to the loudspeaker if required. In a first stage, the signal is passed through an amplifier 41 having a gain G whereafter it is passed through a half-wave rectifier 42 that generates a uni-directional signal which increases as the audio signal increases. Finally, the rectified signal is passed to a current generator 43 which generates a current proportional to the input uni-directional signal that is suitable for driving the light 44.

Sensor indicator light- At the top of the housing a red light emitting diode and a green light emitting diode are located behind a translucent cover 28. The green LED is lit whenever movement is detected by the sensor pad connected to the transmitter. This provides a visual representation of the electronic "clicks" detected by the antenna. If no signal has been produced for a predetermined time, say 20 seconds, the red LED is lit as a warning indicator.

Power indicator- A small red light emitting diode 30 is provided on the front of the housing that is illuminated when the unit is switched on. As the power source level drops the light will flash as a warning.

Soundseek switch- The front of the housing is provided with a button 32 that enables an electronic processing circuit to be activated or deactivated. This is known as the "Soundseek" circuit. This comprises a circuit incorporated into the electronic circuitry within the receiving unit and essentially comprises a band pass filter which selectively amplifies those frequencies that are present in sounds generated by a baby whilst rejecting frequencies associated with other background noises.

An example of a suitable Soundseek sub-circuit is illustrated in Figure 10 of the accompanying drawings. Although many alternative configurations can be envisaged within the scope of the invention, the illustrated circuit

provides a particularly cost-effective arrangement as it only requires a single transistor and various linear components (resistors and capacitors).

The input to the sound seek sub-circuit comprises an audio feed from the output of the radio frequency circuitry. This could, for example be taken from an input node to the loudspeaker, or most likely from an input mode to an amplifier that drives the loudspeaker. In the example, the values of the linear components are selected to provide the following parameters of the filter:

centre frequency	= 1.5 kHz
boost	= 4x
3dB bandwidth	= 1kHz (i.e. 500Hz from centre frequency)

A plot of gain versus frequency for this filter is illustrated in Figure 11 of the accompanying drawings. By varying one or more of the linear component values the bandwidth, centre frequency and gain can all be altered to optimise performance of the circuitry. For example, a different response may be provided for selectively amplifying the sound of a baby crying than for amplifying the sound of an elderly person or even an animal. Also, different filters may be needed to deal with different types of background noise.

In a modification, the soundseek circuitry could be incorporated into a unit at the transmitting module so that the sound is selectively amplified before passing through the RF link. However, by providing the circuit at the receiver it can be conveniently switched off if required by the minder using a suitable switch provided on the receiving module.

The electronic circuitry within the receiver module are illustrated in block schematic diagram form in Figure 14 of the accompanying drawings and are as follows:

MCU

This is a single chip microprocessor which can receive all input data and output it to the LCD display, LED indicators and buzzer alarm.

R.F. AMP.

This receives the radio frequency from the antenna, and performs amplification.

Mixer

This mixes the local oscillations with the carrier frequency.

I.F. AMP.

This uses a narrow band I.F. IC for amplification, and outputs the recovered audio signal.

Tone Detector I

This uses a two-state tone filter to detect out the tone signal and convert it to a DC voltage.

Tone Detector II

This uses a two-state tone filter to detect out the data tone signal and convert it to DC levels.

Comparator

This compares the input signal voltage with the preset level, and performs output control.

Power Switch

This is a transistor switch which controls the on/off state of the audio amplifier.

Soundseek

When selected, this filter preferentially amplifies selected frequencies to isolate selected noises from background noise.

Audio AMP

This is to amplify the audio signal, and provides volume control, and outputs it to the speaker.

Light Intensity Driver

This amplifies and rectifies the audio signal and drives the LEDs as a function of sound intensity.

Whilst the illustrated example is suitable for use as a baby monitoring unit the skilled person will appreciate that with some modification within the scope of the invention a unit for monitoring other sounds (such as

elderly people or even animals) can be provided whilst retaining all of the advantageous features of the present invention.

CLAIMS

1. A monitoring unit suitable for enabling a minder to monitor noises made by a person from a remote location, the unit comprising:

a transmitter unit that can be located by a person to be monitored and including a microphone and a transmission means adapted to transmit a signal dependent upon the level of sound measured by the microphone;

a receiver unit adapted to be located by a minder and including a receiver which is adapted to receive the transmitted signal; and

at least one light source, the receiver unit being so constructed and arranged that the intensity of light emitted by the light source is varied as a function of the amplitude of one or more frequencies of sound measured by the microphone.

2. A monitoring unit according to claim 1 in which the light source comprises one or more light emitting diodes.

3. A monitoring unit according to claim 2 in which a plurality of light emitting diodes are arranged in a curved line to represent a smile.

4. A monitoring unit according to any preceding claim in which the light source is only illuminated when sound is detected by the microphone.

5. A monitoring unit according to any preceding claim in which the intensity is varied linearly as a function of sound level between minimum and maximum values.

6. A monitoring unit according to any preceding claim in which the intensity is varied logarithmically as a function of sound level between minimum and maximum values.

7. A monitoring unit according to any preceding claim which further includes a loudspeaker for audible reproduction of the detected sounds.

8. A monitoring unit according to claim 7 which further includes a volume control which permits the volume of sound reproduced by the loudspeaker to be varied with the intensity of illumination of the light source being independent of the setting of the volume control from the loudspeaker.

9. A monitoring unit according to any preceding claim in which a delay is provided so that the intensity of the light decays at a predetermined rate after it is illuminated.

10. A monitoring unit according to any preceding claim in which the audio signal fed to the input of the light circuit is passed through a half-wave rectifier to produce a uni-directional signal before being fed to the light source.

11. A monitoring unit according to any preceding claim in which the transmitter comprises an RF transmitter and the receiver comprises an RF receiver.

12. A monitoring unit substantially as described herein with reference to and as illustrated in the accompanying drawings.

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Claims searched: 1-11

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A, E	GB 2356073 A	(CENTRAL RESEARCH LABS) see abstract	
A	GB 2346042 A	(LINDAM LTD) see especially figure 2 and page 7 line 23 to page 8 line 2	
A	GB 2306275 A	(KINDERTEC) see page 3 lines 9-31	
A	GB 1581679 A	(GENERAL RESEARCH) see page 1 lines 15-19, page 2 lines 120-128 and figures.	
A	WO 93/05582 A1	(GERRY BABY PRODUCTS) see especially page 1 lines 22-27, page 6 lines 9-22 and figure 2	
A	DE 3809088 A	(SCHAFER) see WPI online abstract	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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